

Project Fact Sheet



Power Quality Measurement and Conditioning

Goals

- Determine if there is an economical benefit to using filters for conditioning the electric power used by electric pump motors.
- Quantify the harmonics that are generated by typical irrigation district Variable Frequency Drive controllers.

PROJECT DESCRIPTION

Both active (very expensive) and broad band passive (less expensive) filters are available to condition the power into motors. However, they are not used in agricultural motor installations. The economics of their future usage will depend upon (i) the amount of harmonics that are present in the power supply, (ii) the degree to which the poor incoming power quality impacts the motor efficiency, and (iii) the relative costs of the filters and benefits of improved motor efficiency. Documentation of these three aspects will indicate if it is worthwhile for CEC and electric utilities to encourage farmers (and others) to install power filters. Documentation will also assist others in determining the value of investigating source control of harmonics.

A possible source of power harmonics is existing Variable Frequency Drive (VFD) controllers, which are becoming more popular with irrigation districts. The popularity arises from advantages in both improved water pressure/water level control and power savings. The non-linear loads of VFDs generate voltage and current harmonics that can have adverse effects on equipment designed for operation as linear loads – the nature of the problem that was previously described. Transformers that bring power into an industrial environment are subject to higher heating losses due to harmonic generating sources to which they are connected. When capacitors are used for power factor improvements (where non-linear loads exist), resonance conditions can occur that may result in even higher levels of harmonic voltage and current distortion thereby causing equipment failure, and disruption of power service.

A question to be addressed by this second aspect of this task is: By how much does the power quality on the line degrade due to typical agricultural irrigation district VFD installations? The answer may show that there is a negligible impact, that improved design and installation standards should be developed and enforced, or that it is best to concentrate upon the usage of filters for incoming power.

BENEFITS TO CALIFORNIA

Energy Efficiency Benefits:

- Reduction in on-farm groundwater pumping (because surface water deliveries

- will be more flexible, and pumping water levels will remain at higher levels),
- Increased crop yield per unit of energy consumed,
- More efficient fertilizer practices,
- Reduced vehicular travel (due to automatic systems and remote monitoring),
- Reduced deterioration of groundwater quality and quantity, and
- Reduced pumping by the irrigation districts themselves.

FUNDING AMOUNT

California Energy Commission: \$116,819

PROJECT STATUS

Part of the activities of this task overlap with the explanation of VFDs, for Task 2. CalPoly has met with a number of integrators and VFD manufacturers, and are about 95% complete on this. What was a surprise was that the existing specifications IEEE standards were actually designed for allowable harmonics on the supply side of utility transformers, yet in many cases, the manufacturers of VFDs have been held to those standards – even though the harmonics decline appreciably over the transformer. What CalPoly has focused on now are the specifications regarding phases and UF disturbance – things that influence the life of the motor and disturbance to passersby (audible noise or radio interference). After experimenting with various sensors attached to PLCs (Programmable Logic Controllers) exposed to dirty power, it is concluded that there is no potential harm to sensor integrity.

Based on what is known now, it has been decided to no longer run more field tests. Instead, the focus will be on learning more about how to specify the VFD units themselves to minimize harmonics problems. Because there is no good IEEE (or other) standard for meaningful VFD controller specifications, CalPoly will closely examine the various manufacturer specifications and develop a good specification list that is not gold-plated yet which protects the motor and the line.

Following this, CalPoly will write up a brochure. However, the knowledge gained has been continually used to upgrade the VFD specifications that ITRC uses to assist districts, and this knowledge is also used in short courses – such as the advanced pump short course scheduled for late August 2002.

FOR MORE INFORMATION

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